

Appendix H

Data Management Rules

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ABBREVIATIONS

cPAH	carcinogenic polycyclic aromatic hydrocarbon
EPA	US Environmental Protection Agency
GPS	global positioning system
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD	heptachlorodibenzo- <i>p</i> -dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo- <i>p</i> -dioxin
HxCDF	hexachlorodibenzofuran
LDW	Lower Duwamish Waterway
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
OCDD	octachlorodibenzo- <i>p</i> -dioxin
OCDF	octachlorodibenzofuran
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	Pre-Design Investigation
PeCDD	pentachlorodibenzo- <i>p</i> -dioxin
PeCDF	pentachlorodibenzofuran
PEF	potency equivalency factor
RAL	remedial action level
RI/FS	remedial investigation/feasibility study
RL	reporting limit
SIM	selected ion monitoring
SMS	Washington State Sediment Management Standards
TCDD	tetrachlorodibenzo- <i>p</i> -dioxin
TCDF	tetrachlorodibenzofuran
TEF	toxic equivalency factor
TEQ	toxic equivalent
TOC	total organic carbon

This appendix summarizes data management rules being followed for the remedial design of the upper reach of the Lower Duwamish Waterway (LDW). The rules summarized herein are the same as those applied to the remedial investigation/feasibility study (RI/FS) and baseline pre-design studies datasets, except as noted in this appendix.

1 Averaging Laboratory Duplicate or Replicate Samples

Contaminant concentrations obtained from the analysis of laboratory duplicates or replicates (i.e., two or more analyses on the same sample) will be averaged for a closer representation of the “true” concentration than that provided by the results of a single analysis. Averaging rules will be dependent on whether the individual results are detected concentrations or reporting limits (RLs) for non-detected analytes. If all concentrations are detected for a given parameter, the values will be simply averaged arithmetically. If all concentrations are non-detected for a given parameter, the minimum RL will be reported. If the concentrations are a mixture of detected and non-detected concentrations, any two or more detected concentrations will be averaged arithmetically, and RLs for the non-detected results will be ignored. If there is one detected concentration and one or more non-detected results, the detected concentration will be reported. The latter two rules will be applied regardless of whether the RLs are higher or lower than the detected concentration.

2 Field Duplicate Results

Field duplicate results are collected to assess environmental sample data variability. In the design dataset, the parent sample results will be selected to represent the location, unless the contaminant concentration in the field duplicate sample exceeds the remedial action level (RAL) and the contaminant concentration in the parent sample does not. In that case, the field duplicate results (all analytes) will be selected for the location.

3 Re-occupying Locations

Surface sediment locations are considered to have been successfully re-occupied if a more recent sample has been collected within 10 ft of an older sample. The results for the most recent sample are selected to represent the current conditions. If an older sample includes data for contaminants not analyzed in the more recent sample, then the results from the older sample for that contaminant are retained for that location. This approach has been followed consistently since the establishment of the RI dataset (LDW RI Appendix E (Windward 2003)). The purpose of this rule is to include the most current result available for the 0–10-cm interval, since contaminant concentrations in surface sediment can change over time as new sediment is deposited.

The 10-ft rule is consistent with inherent measurement error in the differential global positioning systems (GPSs) used in sampling surveys for the Phase I Pre-Design Investigation (PDI) and past

sampling efforts. The differential GPS used for Phase I PDI has a measurement error of approximately 3–6 ft. Given the inherent measurement error, it is not possible to definitively distinguish different sampling locations within 10 ft of one another for samples collected after 2001. Prior to 2001, GPS technology was less accurate, so measurement errors may have been greater. If a re-occupied station location was greater than 10 ft away from the old location, it was considered a separate sample location and the both the newer and older data were retained.

4 Selection of Preferred Results

In some instances, the laboratory will generate more than one result for a chemical for a given sample. Multiple results can occur for several reasons, including:

- The original result does not meet the laboratory's internal quality control guidelines, and a reanalysis is performed.
- The original result does not meet other project data quality objectives, such as a sufficiently low RL, and a reanalysis is performed.
- Two different analytical methods are used for that chemical.

In each case, a single result will be selected for use. The procedures for selecting the preferred result will differ depending on whether a single or multiple analytical methods are used for that chemical.

For the same analytical method, the results will be selected using the following guidance:

- If the results are detected and not qualified, then the result from the lowest dilution will be selected, unless multiple results from the same dilution are available, in which case the result with the highest concentration will be selected.
- If the results are a combination of estimated (J-flagged) and unqualified detected results, then the unqualified result will be selected. This situation most commonly occurs when the original result is qualified because the result is outside of the calibration range, thus requiring a dilution. The diluted result within the calibration range will be preferentially selected.
- If the results are all estimated, then the result will be selected using best professional judgment and considering the rationale for qualification. For example, a result qualified based on laboratory replicate results outside of quality control objectives for precision will be preferred to a qualified result that is outside the calibration range.
- If the results are a combination of detected and non-detected results, then the detected result will be selected. If there are more than one detected result, the applicable rules for multiple results (as discussed above) will be followed.
- If the results are all non-detected, then the lowest RL will be selected.

For different analytical methods (i.e., when a specific chemical is analyzed in the same sample using different methods), the following rules will be applied:

- For polychlorinated biphenyls (PCBs) analyzed as congeners using US Environmental Protection Agency (EPA) Method 1668C and as Aroclors using EPA 8082A , the higher of the two PCB sums will be selected.
- For results analyzed using the semivolatile organic compound full-scan (EPA 8270) and selected ion monitoring (SIM) (EPA 8270-SIM) methods, the SIM results will be selected.
- For results analyzed using EPA Method 8081A and any 8270 method (i.e., hexachlorobenzene and hexachlorocyclopentadiene), the 8081A result will be selected.

The RI/FS database rules for the selection of preferred results between two methods (as described above) were revised for the compilation of the pre-design baseline data (i.e., after the RI/FS baseline data and before the design dataset) In the RI/FS, the preferred result was selected based on a comparison between the methods of the detection status, RL, and data qualifiers. The revised rules select the preferred result based on a preference for method.

5 Significant Figures and Rounding

The analytical laboratories report results with various numbers of significant figures depending on the instrument, parameter, and concentration relative to the RL. The reported (or assessed) precision of each observation will be explicitly stored in the project database as a record of the number of significant figures assigned by the laboratory. The tracking of significant figures will become important when calculating averages and performing other data summaries.

When a calculation involves addition, such as totaling PCBs or polycyclic aromatic hydrocarbons (PAHs), the calculation will be only as precise as the least precise number that goes into the calculation. For example (assuming two significant figures):

$210 + 19 = 229$ will be reported as 230 because 19 is only reported to 2 significant digits, and the enhanced precision of the trailing 0 in the number 210 is not significant.

When a calculation involves multiplication or division, such as carbon normalization, the original figures for each value are carried through the calculation (i.e., individual values are not adjusted to a standard number of significant figures; instead, the appropriate adjustment is made to the resultant value at the end of the calculation). The result is rounded at the end of the calculation to reflect the value with the fewest significant figures used in the calculation. For example:

$59.9 \times 1.2 = 71.88$ will be reported as 72 because there are 2 significant figures in the number 1.2.

When rounding, if the number following the last significant figure is less than 5, the digit will be left unchanged. If the number following the last significant figure is equal to or greater than 5, the digit will be increased by 1.

6 Calculating Totals

Total PCBs, total PAHs, and total fines will be calculated by summing the detected values for the individual components (e.g., Aroclor mixtures or individual congeners for total PCBs). For samples in which none of the individual components are detected, the total value will be given as the highest RL of any individual component, and assigned a U-qualifier (no detected concentrations). No sum will be calculated in cases where 50% or less of the components are analyzed. Concentrations for analyte sums will be calculated using the following components:

- Total PCBs as the sum of Aroclors will be calculated, in accordance with the methods of the Washington State Sediment Management Standards (SMS), using only detected values for all Aroclor mixtures. For individual samples in which none of the Aroclor mixtures are detected, total PCBs will be given a value equal to the highest RL of the Aroclors and assigned a U-qualifier (no detected concentrations).
- Total PCBs as the sum of PCB congeners will be calculated using only the detected congener values. For individual samples in which none of the congeners are detected, total PCBs will be given a value equal to the highest RL of the congeners and assigned a U-qualifier (no detected concentrations).
- Total low-molecular-weight PAHs (LPAHs), high-molecular-weight PAHs (HPAHs), PAHs, and benzofluoranthenes will also be calculated in accordance with the methods of the SMS. Total LPAHs will be the sum of detected concentrations for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Total HPAHs will be the sum of detected concentrations for fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Total benzofluoranthenes will be the sum of the b (i.e., benzo(b)fluoranthene), j, and k isomers.
- Because the j isomer is rarely quantified, the total benzofluoranthenes sum will be typically calculated with only the b and k isomers. In cases where the laboratory provides total benzofluoranthenes instead of or in addition to the b and k isomers, the laboratory result will be reported, and no sum will be calculated. For samples in which all individual compounds within any of the three groups described above are non-detected, the highest RL for that sample will represent the sum.
- Total fines will be calculated as the sum of clay and silt fractions (i.e. <62.5 µm).

7 Calculation of Dioxin/furan Congener TEQs

Dioxin/furan congener toxic equivalents (TEQs) will be calculated using the World Health Organization consensus TEF values for mammals (Van den Berg et al. 1998; Van den Berg et al. 2006) as presented in Table J-1. The TEQ will be calculated as the sum of each dioxin/furan congener concentration multiplied by the corresponding TEF value. When the dioxin/furan congener concentration is reported as non-detected, then the TEF will be multiplied by one-half the RL.

Table J-1
Dioxin/furan Congener TEF Values

Dioxin/Furan Congener	TEF Value for Mammals (unitless) ¹
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,7,8-HxCDF	0.1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDF	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,7,8-PeCDF	0.03
1,2,3,7,8-PeCDD	1
2,3,4,6,7,8-HxCDF	0.1
2,3,4,7,8-PeCDF	0.3
2,3,7,8-TCDF	0.1
2,3,7,8-TCDD	1
OCDF	0.0003
OCDD	0.0003

Notes:

- From Van den Berg et al. (2006).
 HpCDD: heptachlorodibenzo-*p*-dioxin
 HpCDF: heptachlorodibenzofuran
 HxCDD: hexachlorodibenzo-*p*-dioxin
 HxCDF: hexachlorodibenzofuran
 OCDD: octachlorodibenzo-*p*-dioxin
 OCDF: octachlorodibenzofuran
 PeCDD: pentachlorodibenzo-*p*-dioxin
 PeCDF: pentachlorodibenzofuran
 TCDD: tetrachlorodibenzo-*p*-dioxin
 TCDF: tetrachlorodibenzofuran

TEF: toxic equivalency factor

8 Calculation of Carcinogenic Polycyclic Aromatic Hydrocarbons

Carcinogenic polycyclic aromatic hydrocarbon (cPAH) values will be calculated using potency equivalency factor (PEF) values (California EPA 2009) based on the individual PAH component's relative toxicity to benzo(a)pyrene. PEF values are presented in Table J-2. The cPAH will be calculated as the sum of each individual PAH concentration multiplied by the corresponding PEF value. When the individual PAH component concentration are reported as non-detected, then the PEF will be multiplied by one-half the RL.

Table J-2
cPAH PEF values

cPAH	PEF Value (unitless) ¹
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Dibenz(a,h)anthracene	0.4
Indeno(1,2,3-cd)pyrene	0.1

Notes:

1. PEFs for cPAHs are defined by California EPA (2009) by dividing the inhalation unit risk factor for the compound by the inhalation unit risk factor for benzo[a]pyrene.

cPAH: carcinogenic polycyclic aromatic hydrocarbon

EPA: US Environmental Protection Agency

PEF: potency equivalency factor

9 TOC Normalization

Most RALs are organic carbon (OC)-normalized values. Organic carbon-normalized concentrations are calculated by dividing the dry weight concentration by the percent total organic carbon (TOC) expressed as a fraction. For example, a dry weight PCB concentration of 240 µg/kg in a sample with 2% TOC has a TOC-normalized PCB concentration of 12 mg/kg OC, per Equation 1:

$$\frac{240 \mu\text{g/kg}}{0.02} = 12,000 \mu\text{g/kg} = 12 \text{ mg/kg} \quad \text{Equation 1}$$

Sediment samples with TOC content < 0.5% or > 3.5% will not be TOC normalized for comparison to the organic carbon-normalized RALs and SMS criteria (Ecology 2019). When TOC normalization is not possible, a dry weight equivalent concentration is used (see Table 8-1 in Ecology 2019).

10 References

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